

A NEW HOST RECORD FOR *DASYCHERNES INQUILINUS* (ARACHNIDA, PSEUDOSCORPIONES, CHERNETIDAE), WITH AN OVERVIEW OF PSEUDOSCORPION-BEE RELATIONSHIPS

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ABSTRACT. *Dasychernes inquilinus* Chamberlin 1929, the type species of the genus, was described from specimens taken from colonies of the stingless honey bee *Melipona salti* Schwarz 1932 (Hymenoptera, Apidae). For the first time since its description, we report *D. inquilinus* from a nest of *M. compressipes* (Fabricius 1804) and, to document intraspecific variation, we also provide descriptive notes on the female pedipalp and leg. We discuss the rareness of *D. inquilinus* and summarize published information on pseudoscorpion-bee relationships. We found a total of 15 pseudoscorpion species (six genera in three families) reported from colonies of three stingless bee species and two honey bee species. The role of pseudoscorpions within bee nests is still poorly known. Like our notes on *D. inquilinus*, most records of pseudoscorpion-bee relationships are sporadic observations, sparsely reported in the literature.

Keywords: Taxonomy, Colombia, neotropical, stingless bees, honey bees

The purposes of this note are to report *Dasychernes inquilinus* Chamberlin 1929 (Arachnida, Pseudoscorpiones, Chernetidae) from a nest of the stingless honey bee *Melipona compressipes* (Fabricius 1804) (Hymenoptera, Apidae, Meliponini), and summarize published information on pseudoscorpion-bee relationships. *Dasychernes* Chamberlin 1929, a Neotropical genus of melittophilous pseudoscorpions or pseudoscorpions exclusively associated with bees, contains four species associated with colonies of the stingless bee genera *Melipona* Illiger and *Trigona* Jurine (Mahnert 1982, 1987; Harvey 1991). *Dasychernes inquilinus*, the type species of the genus, was described from specimens collected inside two colonies of *Melipona salti* Schwarz 1932 (= *M. interrupta* Latr. var. *salti*) on the Caribbean coast of Colombia (Chamberlin 1929; Salt 1929; Mahnert 1982). In addition to representing a new host association, the record of *D. inquilinus* is noteworthy because of the rareness of this species. Despite the amount of stingless bee research and beekeeping in the tropical regions of the Amer-

icas, *D. inquilinus* has not been more frequently recorded.

We found a total of 15 pseudoscorpion species (six genera in three families) reported from colonies of three stingless bee species and two honey bee species (*Apis* Linnaeus) (Table 1). The role of pseudoscorpions within bee nests is still poorly known, and like our observations on *D. inquilinus*, most records of pseudoscorpion-bee relationships are sporadic, sparsely reported in the literature. We hope to draw more attention to and encourage future studies on the ecological role of these interesting associations.

On December 2004, we found specimens of *D. inquilinus* while transferring a wild colony of *M. compressipes* to a wooden box. This bee colony was found in Cunday, Departamento of Tolima (4°00'5.5"N, 74°74'4.4"W; ~500 m elev.), Colombia, inside a cavity formed by rocks at 40 cm above the ground.

Voucher specimens of *D. inquilinus* are deposited in the Geneva Natural History Museum, Switzerland (MHNG) (1 ♀, 1 ♂

Table 1.—Melittophilous pseudoscorpions and their hosts or commensals. Bee host/commensal: 1 = the presence of *C. cancroides* inside *A. mellifera* colonies seems to be sporadic because it has also been reported from mammal and bird nests, and human constructions (Donovan & Paul 2005; Villegas-Guzman & Pérez 2006); 2 = due to morphological similarity between *Dasychernes* and *C. sellowi*, the only species of *Corosoma*, it has been suggested that the latter genus might also be associated with stingless bees (Mahnert 1982, 1987).

Species	Bee host/commensal	Location	References
CHELIFERIDAE			
APIDAE: APINI			
<i>Chelifer cancroides</i> (Linnaeus 1758)	<i>Apis mellifera</i> Linnaeus 1758 ⁽¹⁾	Cosmopolitan	Donovan & Paul 2005
<i>Ellingsenius fulleri</i> (Hewitt & Godfrey 1929)	<i>A. mellifera</i>	Spain, Cyprus, Iran, Oman, South Africa	Beier 1948; Judson 1990; Donovan & Paul 2005
<i>E. globosus</i> Beier 1962	<i>A. mellifera</i>	Rwanda	Beier 1948; Donovan & Paul 2005
<i>E. hendrickxi</i> Vachon 1954	<i>A. mellifera</i>	Zaire	Beier 1948; Donovan & Paul 2005
<i>E. indicus</i> Chamberlin 1932	<i>A. mellifera</i> , <i>A. cerana</i> Fabricius 1793	India	Beier 1948; Subbiah et al. 1957; Murthy & Venkataramanan 1985, 1986; Donovan & Paul 2005
<i>E. sculpturatus</i> (Lewis 1903)	<i>A. mellifera</i>	California (USA), Namibia, Zaire, Zimbabwe, South Africa	Beier 1948; Harvey 1991; Donovan & Paul 2005
<i>E. perpustulatus</i> Beier 1962	<i>A. mellifera</i>	Kenya	Beier 1948; Donovan & Paul 2005
<i>E. ugandanus</i> Beier 1935	<i>A. mellifera</i>	Uganda	Beier 1948; Donovan & Paul 2005
CHERNETIDAE			
<i>Chernes cimicoides</i> (Fabricius 1793)	<i>A. mellifera</i>	Austria	Beier 1948
APIDAE: MELIPONINI			
<i>Corosoma sellowi</i> Karsch 1879	Meliponini ⁽²⁾	Brazil	Mahnert 1982, 1987
<i>Dasychernes inquilinus</i> Chamberlin 1929	<i>Melipona salti</i> Schwarz 1932, <i>M. compressipes</i> (Fabricius 1804)	Colombia	Salt 1929; this work
<i>D. panamensis</i> Mahnert 1987	<i>Trigona nigerrima</i> Cresson 1878	Panama	Mahnert 1987
<i>D. roubiki</i> Mahnert 1987	<i>T. nigerrima</i>	Panama	Mahnert 1987
<i>D. trigonae</i> Mahnert 1987	<i>T. nigerrima</i>	Panama	Mahnert 1987
WITHIIDAE			
APIDAE: APINI			
<i>Withius simoni</i> (Balzan 1892)	<i>A. mellifera</i>	South Africa	Beier 1948

and 1 tritonymph), the Instituto de Ciencias Naturales, Universidad Nacional de Colombia, and in the Museo Javeriano de Historia Natural Lorenzo Uribe, Pontificia Universidad Javeriana, Bogotá, Colombia (2 ♀, 2 ♂, 2 tritonymphs, 4 deutonymphs, and 3 protonymphs).

Biological observations.—We counted at least ten individuals (males, females, and immatures) of *D. inquilinus* crawling inside the inner walls

of the bee nest cavity, as well as over bee fecal masses within the nest and brood combs containing old bee pupae (Fig. 1). We also found an oviposition or molting chamber of *D. inquilinus* made inside an empty bee cell. This chamber was built up by a whitish silk membrane and had a single *D. inquilinus* adult. We did not make any effort to quantify and locate all *D. inquilinus* individuals to avoid damaging the bee colony.



Figure 1.—The melittophilous pseudoscorpion, *Dasychernes inquilinus*, on a *Melipona compressipes* brood comb from a nest found in central Colombia.

Taxonomic observations.—The two adult specimens of *D. inquilinus*, deposited in MHNG, possess the morphological and morphometric characters indicated in the original description and subsequent publications (Chamberlin 1929, 1931; Mahnert 1982). To further document intraspecific variation, the following are additional comments on the female pedipalp and leg: pedipalp indistinctly granulate, chela hand near base of movable finger with a cluster of finely dentate setae, both chelal fingers externolaterally with numerous sense spots, lateral side of fixed finger with numerous microchaetae in distal quarter; fixed finger with approximately 95 small marginal teeth, 15 externolateral accessory teeth and 7 internolateral accessory teeth, movable finger with approximately 85 marginal teeth, 13 externolateral, and 9 internolateral accessory teeth; nodus ramosus of venom duct at level of trichobothrium *t*. Setae on leg I of equal length, finely dentate and acute, setae on leg IV distinctly longer than those of leg I, the ventral setae on femur + patella longer than lateral and dorsal ones, dorsal setae of tibia distinctly longer than the ventral ones (like those in species of *Pachychernes* Beier 1932, but less numerous), tarsus without tactile seta.

Measurements (in mm): total length 5.00; cephalothorax 1.50/1.90; pedipalps: trochanter

2.0 times longer than broad (0.93/0.47), femur 2.9 times (1.48/0.50), patella 2.7 times (1.40/0.51), chela hand with pedicel 1.9 times (1.27/0.66), movable finger 1.17 times longer than hand with pedicel, length 1.49, chela with pedicel 4.0 times longer than broad, length 2.64; leg I: femur 1.55 times longer than deep (0.63/0.40), patella 1.5 times longer than femur and 2.7 times longer than deep (0.96/0.35), tibia 4.0 times (0.89/0.22), tarsus 5.0 times (0.87/0.17); leg IV: femur + patella 3.6 times longer than deep (1.70/0.48), tibia 5.7 times (1.32/0.23), tarsus 5.6 times (1.05/0.19).

Pseudoscorpion-bee relationships.—The presence of adults and immatures of *D. inquilinus* inside the nest cavity, as well as the oviposition or molting chamber within the brood comb of *M. compressipes*, suggest that *D. inquilinus* was not only occupying but also reproducing within the nest at the time it was found. These observations are similar to those of Salt (1929) on *D. inquilinus* inside *M. salti* nests.

Dispersal by phoresis is common among pseudoscorpions in the family Chernetidae (e.g., Muchmore 1971; Zeh & Zeh 1992a, 1992b; Aguiar & Bührnheim 1998). Pseudoscorpions associated with *Apis* could disperse long distances when the colony swarms, as it has been observed in *Ellingsenius indicus* Chamberlin 1932 (Murthy & Venkataraman

1985, 1986). This might not be the case for those associated with stingless bees. Unlike *Apis*, new colonies of stingless bees depend entirely for weeks or months upon the mother colony. Thus, a new colony is usually very close to the old one, with workers bringing back and forth nesting materials and food (Michener 2000). If pseudoscorpions are present in one colony, then they are likely to be found in other nearby colonies. Likewise, host switching in melittophilous pseudoscorpions is likely to occur when bees forage for food or nesting materials on the same flower or collecting areas. For example, stingless bee colonies rapidly acquire flightless scotocryptine beetles (Coleoptera, Leiodidae) in this manner, when infested colonies are introduced to the same area (Roubik & Wheeler 1982). This suggests that melittophilous pseudoscorpions might disperse in the same way. In addition, although there is no evidence, melittophilous pseudoscorpions might also disperse using parasitic bees. For instance, *Dasychnes* could disperse during the attacks of *Lestrimelitta* Friese, a genus of cleptoparasitic stingless bees. *Lestrimelitta* is widely distributed in the Neotropical region and forage exclusively on nests of other stingless bees, including colonies of *Melipona*, *Trigona* and sometimes *Apis* (Michener 2000).

The two *Melipona* species associated with *D. inquilinus* (*M. salti* and *M. compressipes*), although widely spread in Colombia, are not commonly found (Gonzalez, pers. obs.). While we found 21 nests of *M. fuscipes* Friese, we only found one nest of *M. compressipes* despite an intensive survey in more than 400 hectares in Cunday (Mantilla, pers. obs.). Considering the phoretic means of dispersal and potential host switch, it would seem likely to find *D. inquilinus* associated with other abundant sympatric species, such as *M. fuscipes*. However, no individuals of *D. inquilinus* have been observed in any of the *M. fuscipes* colonies examined thus far.

Due to their small size and their smooth, slow movements or long periods of immobility, pseudoscorpions might be overlooked inside bee colonies by bee biologists. However, the large size of *D. inquilinus* (5–6 mm, about half as long as the bees) would make them more conspicuous than other pseudoscorpions. Surprisingly, despite the amount of stingless bee research and beekeeping in the tropical regions of the Americas, *D. inquilinus* has not been more frequently recorded. The only record that

might correspond to *D. inquilinus* is that of Beier (1948), who mentioned an unidentified pseudoscorpion from a colony of *Melipona scutellaris* Latreille 1811 (= *Melipona mutata* Lepeletier 1836) in Pará, Brazil. It is likely to be *D. inquilinus* because this is the only species associated with *Melipona* colonies, but without examining the specimens, this record is still uncertain. Therefore, *D. inquilinus* seems to be specific to certain *Melipona* species and/or host switching is apparently not very common in this species. These suggestions are strengthened by the facts that no individuals of *D. inquilinus* have been observed in any of the colonies of *M. fuscipes*, a locally abundant sympatric species with *M. compressipes*, and that it has not been more frequently recorded, despite its large size and amount of stingless bee research and beekeeping in tropical America.

Like our observations on *D. inquilinus*, most records on pseudoscorpion-insect relationships are sporadic and, except for the works of Beier (1948), Muchmore (1971), and Aguiar & Bührnheim (1998), sparsely reported in the literature. We found records for a total of 15 pseudoscorpion species (six genera in three families) reported from colonies of three stingless bee species and two honey bee species (Table 1). Species of the genera *Dasychnes* and *Ellingsenius* Chamberlin 1932, and probably *Corosoma* Karsch 1879, a monotypic genus showing morphological similarities to *Dasychnes*, are apparently exclusively associated with bee colonies. There are no obvious morphological characteristics associated with a melittophilous life style. However, *Corosoma* and *Dasychnes* have abundant vestitural setae (Mahnert, pers. obs.), and we speculate that might help them in disguising themselves from the host. Other pseudoscorpions reported from bee colonies seem to be fortuitous cases. For example, the cosmopolitan *Chelifer cancroides* (Linnaeus 1758) has been collected from colonies of *Apis mellifera* Linnaeus as well as from mammal and bird nests, and even human constructions (e.g., Donovan & Paul 2005; Villegas-Guzman & Pérez 2006).

The role of pseudoscorpions within bee nests is still poorly known. The predatory habits of pseudoscorpions suggests that they might prey on aged, decrepit, or sick bees and possibly other associated arthropods inside the colony, including pests. For instance, in colonies of *Apis mellifera* and *A. cerana* Fabricius 1793, *E.*

indicus preys on *Varroa destructor* Anderson & Trueman 2000, a mite that frequently causes the death of an entire colony by feeding on the haemolymph of both adult and immature bees (Donovan & Paul 2005, 2006). Thus, some pseudoscorpion species might be beneficial for beekeepers but certainly negative effects on bee colonies cannot be ruled out. Further studies of the ecological role of pseudoscorpions within bee colonies are needed.

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LITERATURE CITED

- Aguiar, N.O. & P.F. Bührnheim. 1998. Phoretic pseudoscorpions associated with flying insects in Brazilian Amazônia. *Journal of Arachnology* 26:452-459.
- Beier, M. 1948. Phoresie und Phagophilie bei Pseudoscorpionen. *Österreichische Zoologische Zeitschrift* 1:441-497.
- Chamberlin, J.C. 1929. *Dasychernes inquilinus* from the nest of meliponine bees in Colombia (Arachnida: Chelonethida). *Entomological News* 40:49-51.
- Chamberlin, J.C. 1931. The arachnid order Chelonethida. Stanford University Publications, Biological Sciences 7:1-284.
- Donovan, B.J. & F. Paul. 2005. Pseudoscorpions: the forgotten beneficials inside beehives and their potential for management for control of varroa and other arthropod pests. *Bee World* 86:83-87.
- Donovan, B.J. & F. Paul. 2006. Pseudoscorpions to the rescue? Indian pseudoscorpions kill varroa and other arthropod enemies of bees inside hives. *American Bee Journal* 146:867-869.
- Harvey, M.S. 1991. Catalogue of the Pseudoscorpionida. Manchester University Press, Manchester, UK. 726 pp.
- Judson, M.L.I. 1990. Redescription of the bee-associate *Ellingsenius fulleri* (Hewitt and Godfrey) (Arachnida, Chelonethi, Cheliferidae) with new records from Africa, Europe and the Middle East. *Journal of Natural History* 24:1303-1310.
- Mahnert, V. 1982. The pseudoscorpion genus *Corosoma* Karsch, 1879, with remarks on *Dasychernes* Chamberlin, 1929 (Pseudoscorpiones, Chernetidae). *Journal of Arachnology* 10:11-14.
- Mahnert, V. 1987. Neue oder wenig bekannte, vorwiegend mit Insekten vergesellschaftete Pseudoskorpione (Arachnida) aus Südamerika. *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 60:403-416.
- Michener, C.D. 2000. *The Bees of the World*. Johns Hopkins University Press, Baltimore, Maryland. 913 pp.
- Muchmore, W.B. 1971. Phoresy by North and Central American pseudoscorpions. *Proceedings of the Rochester Academy of Science* 12:79-97.
- Murthy, V.A. & R. Venkataramanan. 1985. Contribution to the biology of the pseudoscorpion, *Ellingsenius indicus* Chamberlain. *Indian Bee Journal* 47:34-35.
- Murthy, V.A. & R. Venkataramanan. 1986(1988). *Ellingsenius indicus* (Arachnida; Chelonethi) as a tool to the assessment of the settling nature of honey bee (*Apis cerana indica*) colony, in a new habitat. *Indian Bee Journal* 48:54-55.
- Roubik, D.W. & Q.D. Wheeler. 1982. Flightless beetles and stingless bees: phoresy and scotocryptine beetles (Leiodidae) on their meliponine hosts (Apidae). *Journal of the Kansas Entomological Society* 55:125-135.
- Salt, G. 1929. A contribution to the ethology of the Meliponinae. *Transactions of the Entomological Society of London* 77:431-470.
- Subbiah, M.S., V. Mahadeven & R. Janakiraman. 1957. A note on the occurrence of an arachnid—*Ellingsenius indicus* Chamberlin—infesting bee hives in south India. *The Indian Journal of Veterinary Science and Animal Husbandry* 27: 155-156.
- Villegas-Guzman, G.A. & T.M. Pérez. 2006 (2007). A new species of *Pachychernes* (Pseudoscorpiones, Chernetidae) from México associated with nests of *Neotoma micropus* (Rodentia, Muridae). *Journal of Arachnology* 34:578-585.
- Zeh, D.W. & J.A. Zeh. 1992a. Emergence of a giant fly triggers phoretic dispersal in the Neotropical pseudoscorpion, *Semeiochernes armiger* (Balzan) (Pseudoscorpionida: Chernetidae). *Bulletin of the British Arachnological Society* 9:43-46.
- Zeh, D.W. & J.A. Zeh. 1992b. Failed predation or transportation? Causes and consequences of phoretic behavior in the pseudoscorpion *Dinocheirus arizonensis* (Pseudoscorpionida: Chernetidae). *Journal of Insect Behavior* 5:37-49.

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